



## FIELD REPORT 2010 - Coral and Coastal Ecology of the Seychelles

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**Country** The Seychelles

**Research site / region** Curieuse Island

**Protected area status** Curieuse Island Marine Park

**Date field report completed** February 2011

**Period covered** 1 Jan 2010 to 31 Dec 2010

**Report completed by** Dr David K A Barnes

Dear Earthwatch fellows of the December 2010 Curieuse expedition,

Thanks for great contributions to a very successful research and capacity building two weeks. A broken undercarriage on an aircraft in the Antarctic Peninsula, a volcano in Iceland and snow in the UK made 2010 a challenge to run the Seychelles expeditions as planned and only the one in December was possible in the end. However your diverse experience and skills, team and individual performances and hard work meant that we repeat surveyed Curieuse Marine Park thus enabling us to assess temporal, sample intensity and chance components to assessment of marine invertebrate rarity. This is important as most species recorded from Curieuse Marine Park are 'rare' (are found in 2 or fewer samples) and arguably rare species generally have a higher perceived conservation value. Secondly (partly due to very favourable weather) we made the first survey of the marine invertebrates of Cocos Marine Park, and very interesting this was too - a strong contrast to the species assemblages on Curieuse and Praslin not so far away. Thirdly we found several species including a sea cucumber and a hermit crab that may turn out to be new species and thus only known from Seychelles Marine Parks, which should strengthen their conservation value and profile. Fourthly we carried out impact assessments on two differing hotel builds which should in time give us strong insights into the magnitude and type of anthropogenic effects. Last but not least we hope that the training and discussions we initiated with you, in terms of sample and monitoring design, identification, presentation skills, data visualisation and an introduction to statistics, prove valuable.

With kindest regards,

David Barnes  
Earthwatch Scientist



Team meeting

## SECTION ONE

### Top highlight from the past field season

The first survey of the marine invertebrates of Cocos Marine Park is significant - not least because it represents an important milestone in the project of delivering a complete baseline survey of the marine parks in the granitic islands. Because these have all been carried out at approximately the same time, using the same protocol and team leadership and with identifications checked using primary literature and taxonomists they should serve as an invaluable record of the Parks' status. Cocos is regarded as a 'jewel' by the tourism industry (and the Seychelles National Park Association ) to show off the Seychelles marine environment - yet there was little record of what marine life was present or what its status was. We will now be able to prepare a list and digital photographic archive of species present and attribute importance in terms of rarity, endemism and thus perhaps threats and management strategies. Sometimes a highly significant achievement is not one that is immediately exciting or innovative but builds the platform for the future ability to undertake those things.



View of Curieuse Marine Park, Seychelles

## Non-technical overview of results

The 'Coral and Coastal Ecology of the Seychelles' project has essentially two main strands - one assessing biodiversity across islands, marine parks and spatial scales in the shallows and on the shore and the other using SCUBA to investigate coral ecophysiology and responses to local and wide scale environmental change. In 2010 it was only possible to run one of the four two-week teams, in December, and this focussed on assessment of marine invertebrate biodiversity and improving capacity of Indian Ocean conservational professionals to be able to design, undertake and interpret such assessments. The bigger picture behind the importance of such assessment is of increasing type, frequency and magnitude of impacts spanning regional warming and El Nino events to local tourism and land reclamation. This was highlighted by both 2010 being the target year for the international Convention on Biological Diversity and the widespread view that not enough had been done to assess the threats to biodiversity or management to reduce impacts on it.

In the previous visit, the biodiversity of the shore and shallows team (January 2009) had surveyed three sites in Curieuse Marine Park. This had established that the vast majority of species that were present were rare (using the definition that less than 5 individuals were found or that they were only found in two m<sup>2</sup> quadrats or less). These included new records of sea snails, crabs, sea cucumbers and flatworms for Seychelles and thus confer obvious importance to the places where they were found as the only known location for them in the country. With only one set of samples in this region of Seychelles these findings were hard to place in biodiversity and conservation context. Thus one of the key questions for the 2010 visit was to understand the significance of rarity across these habitats and species (for example were many of these species simply rare because we had not taken enough samples or across a wide enough area to properly record their distribution and if we sampled one of the same sites again would we find the same level of rarity in the same species or lots more different rare species?). Another key question we wanted to try and answer was, do marine parks encompass Seychelles marine invertebrate biodiversity well or not (are there enough parks, are they large enough and are they effective enough?). As the December visit occurred less than one month from the preparation of this report most of these questions are in the early stages of being answered, not least because many of the identities of species we found are currently being checked. However there were some points that are starting to emerge. Firstly the repeat survey of Anse Papaille, Curieuse Island, yielded some important similarities and differences to the 2009 survey. We found that the upper shore was mainly habited by ubiquitous, common and abundant species whilst the shape of lower shore biodiversity was dominated by few common species and many rare ones - as in 2009. Most of these rare ones were not only the same rare ones found on Curieuse in 2009, but those found at this site. This is of more note than on land because so many marine animals have widely dispersive young stages (larvae). We found some new rare species, and some species not found in 2009 that were recorded in more than 2 samples (suggesting patchiness rather than rarity) but broadly the suite of species was similar to the previous survey. However many of the previously recorded species were not seen at all, suggesting genuine rarity, at least at local scale.

Our position on Curieuse Island potentially made travel to, and survey of, Cocos Marine Park difficult. Although survey of Cocos Marine Park (CMP) was a key target for 2010 we were only expecting to undertake this if weather and sea conditions were ideal during the phase of lowest low tides. Flexibility of the work plan meant that we were able to make a first survey of the marine invertebrates of CMP and visited twice in consecutive days to carry this out. The upper shore fauna, as elsewhere we have surveyed, proved to contain the 'usual suspects' but the steep profile of the mid shore resulted in few meaningful samples at this shore level. The lower shore was dominated by a solid coral matrix much like those on atolls, such as Desroches (surveyed by the Earthwatch project in 2006). Likewise the fauna showed strong contrasts with those on Curieuse, Praslin, Silhouette and Mahé but a number of species in common with Desroches. This shows how much habitat can influence fauna over geographic proximity and

local oceanography; both important considerations for conservation. A notable previous finding at Desroches was that biodiversity increased away from the single hotel development and thus the impact of tourism associated building work such as that in the CMP at Félicité Island needs to be closely monitored.



Surveying intertidal zone



Using quadrats to survey upper tidal zone

Seychelles has a high density of conservation organizations and conservation effort but most of the marine work is focused on a few 'charismatic' taxa - the shore and shallows team aimed to broaden and strengthen this by spreading the number of potential indicator taxa and thus ultimately look to see whether patterns in other groups reflected those seen in corals, fish and turtles. The numbers of new records to Seychelles that we have found from very restricted surveys in both space and time show how little knowledge exists on marine biodiversity. Several suspected un-described species were also found, which would be unsurprising if they were in a remote area, or were small or cryptic, but they included a large sea cucumber and a bright blue hermit crab. New species or those only known from marine parks are likely to strongly increase the conservation value and profile of the associated marine parks.

Opportunistically we undertook impact assessments on two hotel builds, both of which had been started since our last surveys and which continue at the time of writing this report. The data from these has not been processed but should provide some insights into what sort of influences these have on adjacent fauna, which groups of animals are most vulnerable and how big the effects are in time and space. This was also a great opportunity in training and demonstration of assessments in action for the team of professionals (Earthwatch fellows) from across organisations and countries.

## **SECTION TWO – TECHNICAL REPORT**

### **REPORTING ON RESEARCH OBJECTIVES**

#### **Objectives**

1) To resurvey at least one site of the three previously surveyed sites on Curieuse Marine Park, Curieuse Island.

This was carried out in full, species images currently having identity confirmed.

2) To survey a new site of suspected high littoral and sublittoral biodiversity in Curieuse Marine Park, on Praslin Island

This was completed in full, data currently under analysis.

3) To undertake a survey of the marine invertebrate biodiversity of Cocos Marine Park. Only one site was located where this was safe and of comparable substrata to surveys recorded elsewhere by this project. Three transects were undertaken but not all shore heights were surveyed due to the profile of the shore. Species images are currently having identity confirmed.

4) Training of 8 Earthwatch Fellows in survey design, implementation and interpretation. As done in previous field seasons each fellow was asked to give a presentation on their work and expectations for the course. We tried to meet these and had specific sections on presentation skills, data visualisation, statistics and their specific questions.

#### **Opportunistic additions**

A) Survey of shore adjacent to developments and controls

A survey was undertaken of a shore adjacent to major development on La Digue and a control shore either side. Similar surveys were conducted adjacent to a development on Praslin and one control site, though there were slight substratum differences which may prove to be a confounding factor in the latter case.

### **RESULTS AND PROGRESS ON OBJECTIVES**

#### **Some preliminary results**

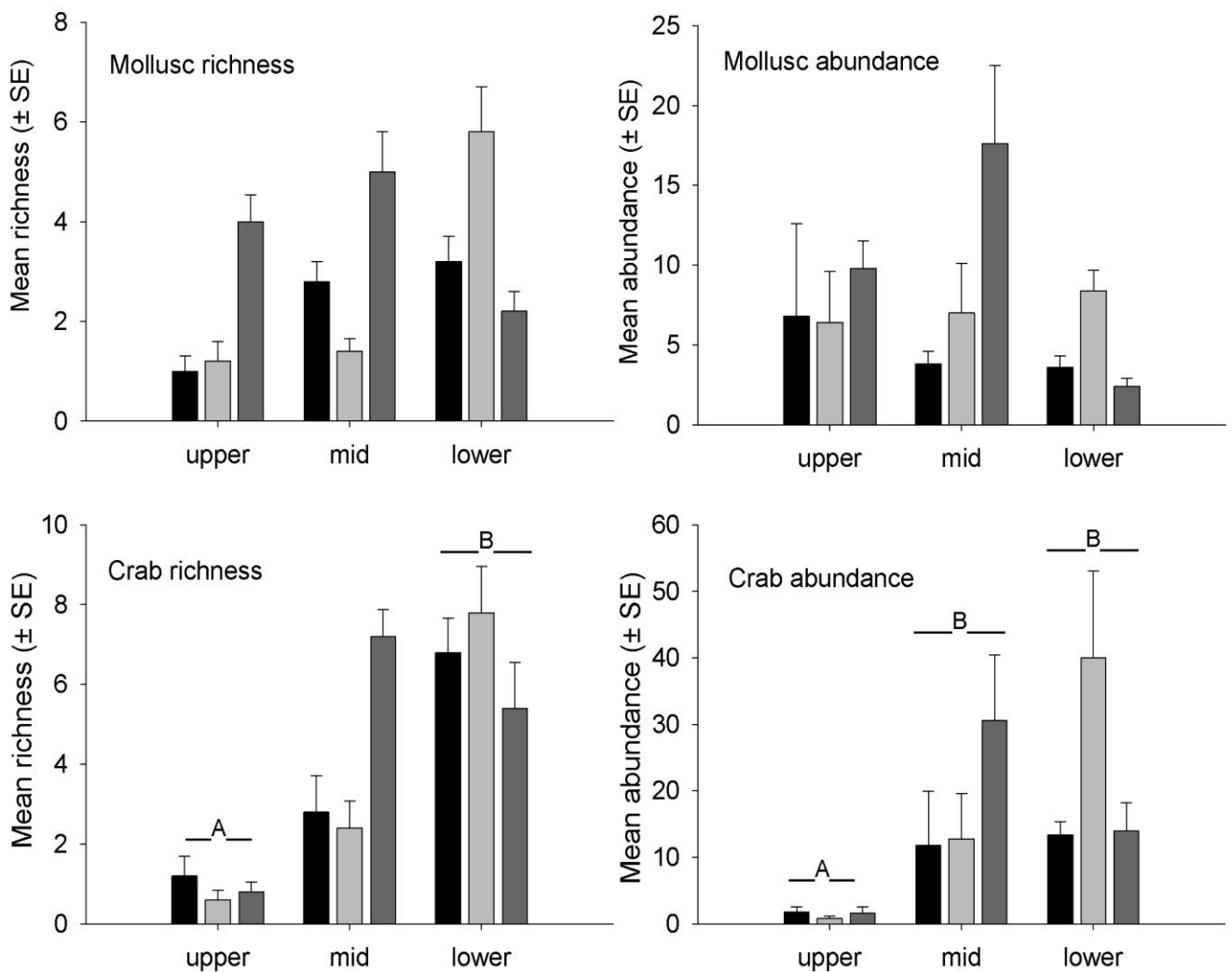
Gastropod and bivalve molluscs (snails and clams) and crabs dominated the littoral fauna in terms of both richness and abundance but other molluscs (chitons and octopus), other crustaceans (barnacles, isopods and amphipods), worms (turbellarians, polychaetes, nemerteans, echiurans and sipunculans), cnidarians (corals, anemones and hydroids), bryozoans, sponges and echinoderms (sea stars, brittlestars, sea cucumbers and sea urchins) were also sporadically present in lower numbers.



Species of flatworms found on surveys

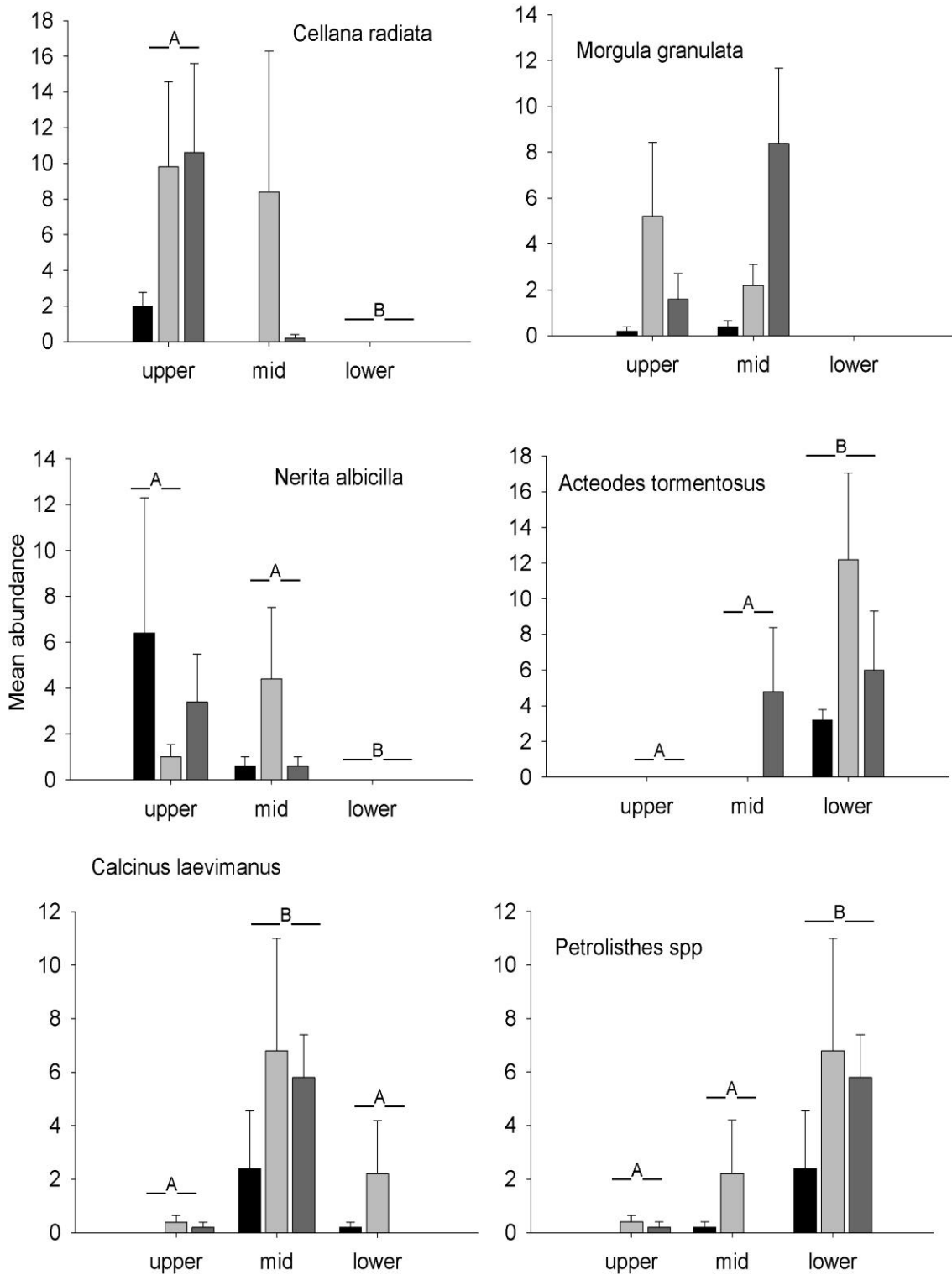
At Anse Papaille, Curieuse Island, mollusc richness varied between shore levels (upper, mid and lower) but non-significantly as variability at the spatial scale of tens of metres (i.e. between transects) obscured any differences (see Figure 1 top left). There was also variability at the metre scale (i.e. between quadrats) but this was smaller than variability at mesoscales. In contrast richness of crabs was lowest on the upper shore and highest on the lower shore (Figure 1 bottom left); with similar levels of variability at the quadrat scale but lower levels of variability at transect scale. The transect variability in Dec 2010 was higher than in Jan 2009 thus further highlighting the complexity of the system in the Marine Park shores and cautions against use of any one taxon, location or spatial scale for long term monitoring of biodiversity, and impacts on it, here.

Unsurprisingly, and as on most Seychelles shores, gastropod molluscs dominated the upper shores in terms of abundance – these were mainly *Nerita* and ittorinid snails. At Anse Papaille, Curieuse Island, mollusc abundance (similarly to richness) did not vary significantly between shore levels (upper, mid and lower) mainly because of high variation between transects but there was also strong metre scale variation as well (Figure 1 top right). In other words mollusc abundance is very patchy on both metre and tens of metre scales and casual observations (snorkelling) suggest this is also the case in the sub-tidal zone. As with richness, crab abundances were lowest on the upper shore but similarly high on the mid and the lower shore levels (Figure 1 bottom right). Similarly to mollusc abundance, crab numbers were very patchy on both metre and tens of metre scales seemingly linked to the rugosity (roughness) and stability on the seabed. Most crabs (and echinoderms) were associated with large, fairly stable, semi-porous boulders.

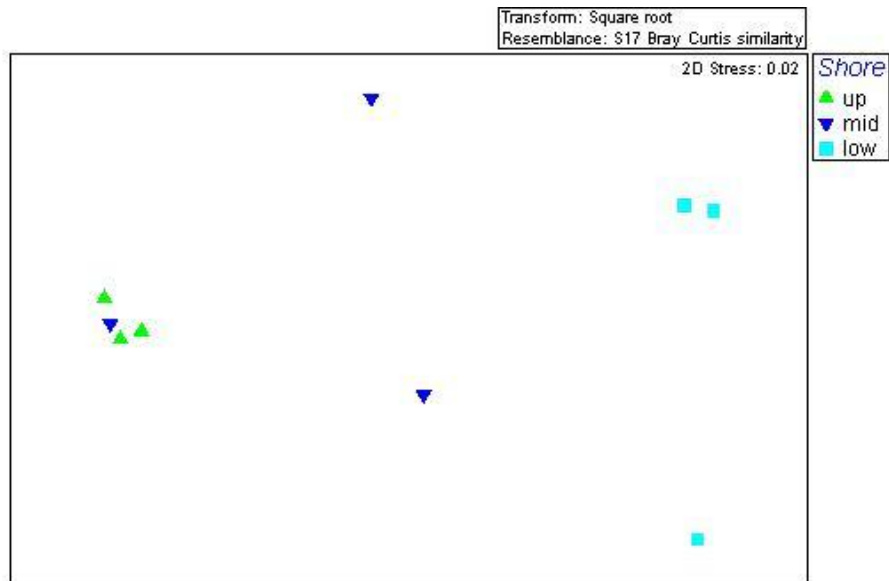


**Figure 1. Mean abundance and richness of molluscs and crabs at the upper, middle and lower tidal zones.**

The structure of communities showed differing patterns to those of gross richness and abundance. Non-metric MultiDimensional Scaling (nMDS) was used as a method of visualising underlying structure to data. Here we use it to compare in two dimensions the species composition of different transects and shore levels (see Figure 3). The points in closest proximity to each other are most similar in terms of the species composition and the low stress level (Figure 3 top right) shows that this two dimensional plot is a strong representation of the true multidimensional data. The plot essentially shows that upper shores have very similar mollusc assemblages and that one midshore is also similar to these. It also shows that there is a transition from upper through middle to lower shore but that below the upper shore transect areas can be as different in their suite of species as between shore levels.

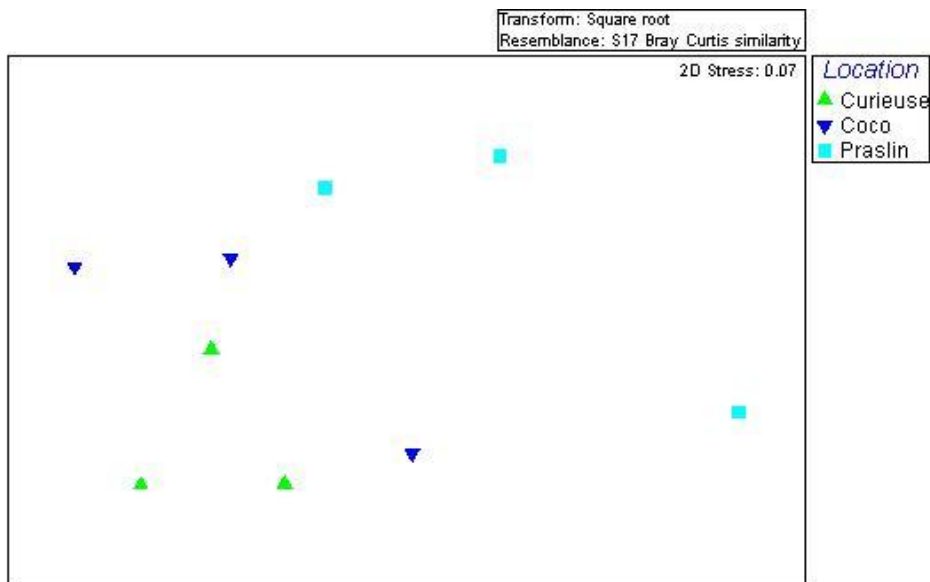


**Figure 2. Mean abundance of mollusc and crab species in upper, middle and lower tidal zones.**



**Figure 3. Non-metric MultiDimensional Scaling (nMDS) plot showing differences in mollusc assemblages between upper (green triangle), lower (blue square) and middle shore areas (blue triangle). Symbols close together show a similarity; symbols far apart show a difference.**

This 'background' level of variability is important to be measured and understood to interpret potential or actual impacts. To investigate variability over a larger spatial scale (km) we compared the lower shore mollusc fauna from similar surveys of Curieuse, Cocos and Praslin shores (we used the lower shore level because mean richness was highest thus giving greatest potential for discriminating any patterns) (see Figure 4).

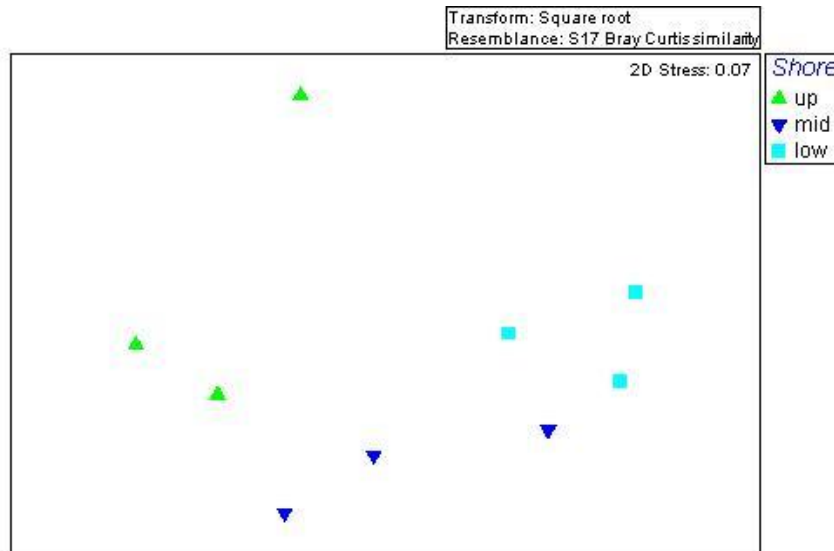


**Figure 4. nMDS plot showing differences in mollusc assemblages on the lower shore between Curieuse Island (green triangle), Cocos (blue triangle) and Praslin (blue square).**

Transects on all three islands showed roughly similar dispersion but assemblages in Cocos Marine Park were intermediate to those on Curieuse and Praslin. This was a surprise for several reasons; the Curieuse and Praslin shores were much closer to each other geographically, seemingly more similar in substratum (all had coral boulder rubble) and level of

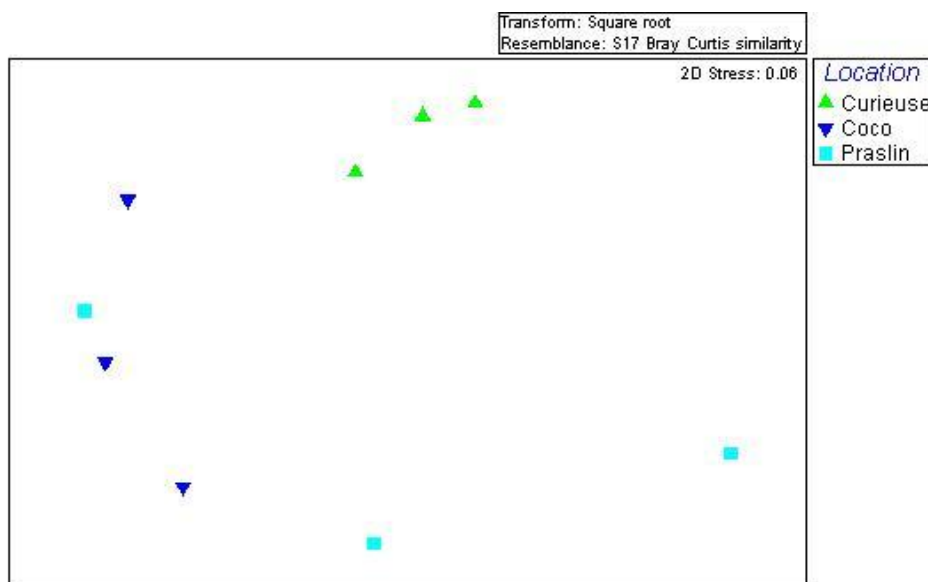
exposure. Detailed analysis in the near future of which species have largely driven this pattern of similarity should enable us to understand and attempt to explain it.

The nMDS plot of crab data from Curieuse Island (Figure 5), as with mollusc data, showed low stress level but other than that differed in most ways.



**Figure 5. MDP of crab assemblages between upper (green triangle), middle (blue triangle) and lower shore areas (blue square).**

The shore levels showed similar levels of dispersion (despite the strong differences in abundance and richness - illustrating the importance of multiple methods of looking at data). The transition from upper through mid to lower shore was quite strong as in molluscs but the shore levels did separate more clearly than in molluscs. At the larger spatial scale Curieuse crab assemblages were distinct but those of Cocos and Praslin not so dissimilar and quite variable between transects (see Figure 6).



**Figure 6. nMDS plot of crab assemblages between Curieuse Island (green triangle), Cocos (blue triangle) and Praslin (blue square).**

These preliminary results give insights into the spatial and (on Curieuse) temporal variability of shore biodiversity across some of the key fauna present. Ultimately not only will this work provide a guide to the most important fauna for conservation (rare or edge of range species, Indian Ocean or Seychelles endemics and undescribed species) but also information crucial to monitoring (and perhaps understanding) their variability in response to natural and anthropogenic impacts. Fieldwork was completed three weeks ago at the time of writing and thus too early for more detailed results.

## **Partnerships**

- The Seychelles Marine Parks Authority by provision and organization of local accommodation, transport, staff, knowledge and facilitating visits (eg to shores adjacent to hotels).
- The Island Conservation Society for enabling rangers from different islands to participate and allowing a guided visit to Cousin Island.
- Nature Seychelles for enabling a ranger from Aride Island to participate.
- Local hotels for supporting surveys along the coastal fringes of their properties.

## **DISSEMINATION**

Barnes, D.K.A., Barnes, R.S.K., Smith, D.J. and Suggett, D. (2009) Littoral biodiversity across scales in the Seychelles, Indian Ocean. *Marine Biodiversity*, 39: 109-119

Barnes, D.K.A., Barnes, R.S.K., Smith, D.J. and Suggett, D. (2009) Coastal fauna of Curieuse Marine National Park. Unpublished 20 page field guide.

In preparation:

Barnes, D.K.A., Barnes, R.S.K., Smale, D., Smith, D.J. and Suggett, D. The nature of rarity in littoral biodiversity amongst Seychelles marine invertebrate biodiversity.

**Visual: artwork; visitor centre, poster or display, slides, photographs**

Hundreds of species photographs

**Digital: database; websites; email group; blog; forum; CD Rom; e-newsletter**

Production of CD